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Editorial

Thematic issue on agricultural systems modelling and software – Part I☆

Dean Holzworth (CSIRO), Ioannis N. Athanasiadis (DUTH), Sander Janssen (WUR), Marcello Donatelli (CRA), Val Snow (AgResearch), Gerrit Hoogenboom (WSU), Jeffrey W. White (USDA-ARS), Peter Thorburn (CSIRO)

Process-based, agricultural systems models have been in use over the last 40 years as tools to evaluate the agronomic, economic and environmental performance of farming systems. They are increasingly applied to problems of both a short-term (e.g. farm performance, crop production monitoring) and long-term (e.g. climate change issues, food security, environmental policy) nature. In 2003, a special issue of the European Journal of Agronomy (van Ittersum and Donatelli, 2003) entitled 'Modelling Cropping Systems' summarized the state of the art in the field. Since that special issue, the challenges facing agricultural models have changed significantly. Global food security and climate change are large external drivers, and the production context is more complex, largely because of the greater demands from the natural resource management aspects of agricultural systems. This has driven many developments in improving agricultural systems models, their implementation as software programs, their inter-comparison in ensemble modelling, and their integration into larger frameworks. Most of these issues are generic and are relevant to other areas of environmental modelling and software. In the past decade, methodological issues related to integrated environmental modelling (Laniak et al., 2013), model performance (Bennett et al., 2013) and model uncertainty (Refsgaard et al., 2007) have also become of great relevance to agricultural modelling and software. With this Thematic Issue we aim to capture the methodological, technical and application advances in agricultural systems modelling and software, to reflect on the drivers of change, and suggest a research agenda for the future.

The research community embraced this Thematic Issue since its inception. Papers were initially solicited by an open call that attracted about eighty abstracts. From these more than fifty full-text manuscripts were submitted and subsequently evaluated by the guest editors and numerous reviewers. This issue presents the first part of the Thematic Issue that is comprised of fifteen manuscripts, while a second part of the Thematic Issue will appear in 2015, together with a position paper on the current status and future prospects of agricultural systems modelling and software. We are grateful to all colleagues who supported the preparation of this Thematic Issue by submitting abstracts and papers. We are also in debt to all reviewers who provided their expert opinion to improve the quality of the submitted manuscripts.

Part I of this Thematic Issue begins with reporting improvements of four established agricultural modelling systems: *Holzworth* et al. present the evolution of APSIM into an agro-ecosystem framework. *Vanuytrecht* et al. introduce improvements in AQUACROP for modelling the effects of various stresses on crop development and production. *Stöckle* et al. report on the evolution of CropSyst to address issues of scale and decision making; while *Bergez* et al. document the integration of STICS into a generic modelling platform.

Advancing agricultural model components at various levels are discussed by *Brown* et al. who present the generic plant modelling framework of APSIM, and *Moore* et al. who contribute with a rule-based framework for modelling farming systems management. Systems issues are highlighted by *Huth* et al. who shed light on oil palm production systems, and by *Snow* et al. who review the major challenges for simulating pastoral farming systems.

The potential of remote sensing in agricultural modelling and decision making is demonstrated by *Machwitz* et al. who assimilate satellite data for yield prediction, and *Yu* et al. for evaluating large-scale, drought-induced yield losses.

Three works tackle the long-standing issues of model calibration, composition and uncertainty; *Archontoulis* et al. present a methodology for calibrating short-day species phenology, *Donatelli* et al. introduce a framework for creating hybrid models by reuse and composition, and *Wallach and Thorburn* study the uncertainty of agricultural models predictions.

The issue concludes with two papers that provide for model interoperability and intercomparison. *Porter* et al. introduce the AgMIP data harmonization mechanism for exchanging experimental data to support ensemble modelling. *Elliot* et al. present the pSIMS framework for massively parallel simulations of climate impact models.

The papers selected for the present issue cover only partially the state-of-the-art of agricultural modelling and software. They are complemented by the second part of this Thematic Issue (to appear in 2015), which includes a position and overview paper on the future of agricultural systems modelling and software.

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